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gineering, entomology, fine art, geography, geology, microscopy, mineralogy, photography, physics, and zoölogy. The associate members of the institute thus constitute a federation of independent departments; but a single admission-fee being required for associate membership, while each member has the privilege of joining as many departments as may be suggested by his individual tastes. For the origination of this plan, as well as for the burden of the work of organization, the credit is due chiefly to Mr. F. W. Hooper, of the Adelphi Academy, Brooklyn.

Aside from the meetings of departments, general meetings of the associate members are periodically held in connection with a course of public lectures. The opening lecture of the first course was given last April by Mr. W. LeConte Stevens, who was followed in successive weeks by Messrs. Robert Spice, George M. Hopkins, and Garrett P. Serviss. The season was closed with an exhibition by the department of microscopy, which was largely attended and in every way successful. The attendance at the public lectures was at first about three hundred, but grew to more than five hundred with the progress of the season.

Departments of entomology and of physics have been organized in addition to those already incorporated in the institute, and others will soon be started in chemistry, mineralogy, and botany. The department of physics held its first meeting on the evening of Sept. 26, when Mr. G. M. Hopkins exhibited a variety of apparatus, largely of his own device, illustrating centrifugal motion and the gyroscope. This was followed by a discussion of the latter instrument introduced by Mr. W. LeConte Stevens and participated in by various other members of the department.

The public lecture course for the coming winter has been already arranged, the opening lecture, on the 11th of October, being by Mr. Bradford of New York, the well-known artist and arctic explorer. Harvard, Yale, Columbia, and the scientific departments at Washington are well represented in the list of lecturers.

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THE AGASSIZ SEASIDE ASSEMBLY.

AT the May meeting of the New Jersey Assembly of the Agassiz Association, held at Rutgers College, New Brunswick, N.J., it was decided to hold a seaside assembly, open not only to members of the Agassiz Association generally, but to all persons interested in the study of natural science. A committee was appointed, with power to make all necessary arrangements. Asbury Park was selected as the place, and the week beginning with Aug. 6 as the time, for the meeting; and Educational Hall was secured for the purpose. Circulars were sent to all the chapters in New England and the Middle States, and also to many persons interested in scientific studies, who were not members of the association. The assembly met on the day appointed, in Educational Hall, Asbury Park. The opening lecture was delivered by Harlan H. Ballard, president of the Agassiz Association, and it was a most inspiring introduction to a week of very successful and delightful work. The mornings of the remaining days of the week were devoted to field-excursions in botany and entomology, the former under the guidance of the Rev. L. H. Lighthipe, and the latter under the Rev. G. D. Hulst, the State entomologist of New Jersey. Tuesday afternoon was devoted to the examination and analysis of plants, many of which, belonging to the 'pine-barrens,' were quite new to most of those present. A paper upon the 'Flora of New Jersey' was contributed by the Rev. L. H. Lighthipe of Woodbridge, N.J., the president of the New Jersey Assembly. On Wednesday afternoon a *conversazione* on 'How to use the Microscope' was held by Prof. F. C. Van Dyck of Rutgers College. Remarks upon the subject were also made by Prof. George Macloskie of Princeton, who also exhibited a most convenient apparatus for the dissection of flowers and insects. In the evening a most interesting lecture upon diatoms was given by Prof. Samuel Lockwood of Freehold, N.J., illustrated by means of the stereopticon. Professor Lockwood has made these interesting microscopical plants the study of his lifetime, and consequently spoke from his own personal observations. His lecture was enjoyed by all; and the fact that his audience could see before them objects which are only visible by means of the microscope, magnified many thousand times,—we might almost say millions,—added very much to its interest. Thursday

was an entomological day. The excursion in the morning was conducted by the Rev. G. D. Hulst, and the afternoon was devoted to the examination of insects collected, and to remarks by the same gentleman upon the collection, preservation, and classification of entomological specimens. In the evening a lecture upon seaweeds was given by Isaac Holden of Bridgeport, Conn. This, like the lecture on diatoms, was made doubly interesting by means of the stereopticon. Mr. Holden also exhibited a large number of beautifully mounted specimens collected by him in the vicinity of his home at Bridgeport. On Friday afternoon, after the examination of the plants collected in the morning, a very instructive lecture was given by Prof. T. O'C. Sloane of the *Scientific American*, and author of 'Home Experiments in Science,' on 'How to make Scientific Experiments with Simple Apparatus.' This was illustrated by actual experiments in physics, made with very simple and inexpensive apparatus. It was a surprise to every one that so much could be accomplished, and so many experiments performed, at so trifling a cost.

The Seaside Assembly adjourned at the close of this lecture, every one present feeling that a very profitable week had been spent. The attendance was not so large as expected, but those who were present felt fully repaid for their coming. A universal desire was expressed that the assembly be held again next summer, and the committee of arrangements were requested to do what they could to accomplish this result. Should this be done, it is hoped that a large number of the chapters will take an active interest in the assembly. Rev. L. H. Lighthipe, Woodbridge, N.J., is chairman of the committee of arrangements, and as such he will be most happy to receive any suggestions that may be offered.

SCIENTIFIC NEWS IN WASHINGTON.

The Library of the Geological Survey: Strong in its Special Fields.—Light and Tree-Growth: Influences of Site and Atmospheric Conditions.

The National Geological Survey Library.

ONE of the most important and practically useful adjuncts of the National Geological Survey is its excellent library. The collection was begun in 1881, almost simultaneously with the establishment of the survey; and in the seven years that have elapsed, about twenty-five thousand bound volumes and more than forty thousand pamphlets have been accumulated. The first important acquisition of the library was in the fall of 1882, when Mr. Darwin, the librarian, negotiated the purchase of the Robert Clarke geological library in Cincinnati. It comprised about two thousand volumes, consisting principally of the reports of State geological surveys. This was the nucleus of what has become the most complete collection of State, United States, and foreign official reports of geological surveys now in existence. There are probably between four thousand and five thousand volumes in this department of the library, including many reports that are rare, and sets that it would be very difficult to duplicate. Of course, even this part of the library is not complete; but it is more nearly so than any other similar collection, and additions are frequently being made to it. It is in constant use by members of the survey preparatory to field-work.

The division of official reports is arranged in the following order: in the first sections are the reports of State surveys classified geographically. This portion of the department comprises a larger number of books than either of the others; and its practical value to the National Survey, as evidenced by its constant use, can hardly be overestimated. The careful study of its volumes prevents the duplication by the National Survey of work already done, and available. It may be interesting to note, in passing, that the first geological report authorized by a State legislature in the United States was ordered by the legislature of North Carolina, and published as a 'memoir' in 1819. It is a thin volume, treating of other topics in addition to the brief and very vague chapters on the geology of the State.

A succeeding portion of this same division contains a very full collection of reports of early United States Government surveys, reconnaissances, etc. Most of these were made under the direction

of the war department, and are especially interesting for the pictures they preserve of the vast area between the Missouri River and the Pacific Ocean before it became accessible to any except military expeditions, specially equipped exploring parties, trappers, and missionaries. Adjoining this section are complete sets of the reports and publications of the several surveys that preceded the National Geological Survey, and from the combination of which it was organized, — the Hayden, Powell, King. Nothing needs to be said of the practical value of this collection. The work of all of these surveys is being embodied in the maps prepared under the direction of Major Powell, and a large portion of it is found available, and adaptable to the uniform system adopted by the National Survey. These comprise all the official geological reports; but they are supplemented by a very full collection of United States Government reports on miscellaneous subjects, principally the resources and industries of the United States and of detached portions of the country. The National Survey itself, or different members, including Major Powell and several of his chief assistants, have made valuable contributions, in the form of reports, monographs, or bulletins, to our knowledge, especially of the resources of the less-understood portions of the country; and some of the most important work now in progress under the direction of the National Survey has to do directly with economic subjects. ¹

Lastly, in the division of official reports, are those of foreign countries. Canada has an excellent geological survey, and its publications are very valuable. European reports are arranged geographically, beginning with those of Russia. France and Germany have no geological surveys, but their commissions to make geological maps of those countries have made important reports. The collection of foreign reports is large.

Second in importance to the division of official reports, is the excellent collection of the transactions and proceedings of geological societies, those of scientific societies, and bound files of scientific periodicals. These occupy a large space in the library, and are constantly put to practical use.

The library has been recently enriched by the purchase in Paris of six hundred and twenty-five volumes, a part of the private library of Desnoyers, a distinguished geologist and writer, and librarian of the Paris Museum of Natural History. Many of these books are presentation copies, containing the autographs of their authors. The books purchased comprised nearly all offered in the divisions of geology, coal, glaciers, artesian wells, volcanoes and earthquakes, the geology of individual countries, mineralogy, and paleontology. Many of these books are rare, and their acquisition greatly enriches the library. A carefully selected general reference-library completes our survey.

In the bibliographical department a card-catalogue of authors, embracing the entire library of books and pamphlets, and consisting of several hundred thousand separate entries, has been finished. In addition to this, there is now in process of preparation a bibliography of North American geology, — a work that will require several years to finish, — and also a bibliography of the official geological reports of the States and of the United States Government. The work upon the latter has been about one-third done.

Probably there is no department of the National Survey library more highly prized than that of maps. Of these there are about twenty thousand, arranged geographically in drawers which admit of their lying flat. None of these are maps made by the National Survey, but they have been gathered from every available source, and constitute the largest and best collection of maps in the United States. A complete catalogue has been prepared, and the larger part of the maps are mounted on linen.

The library is admirably housed. The room devoted to its use is well lighted and ventilated, and not only admits of a most advantageous arrangement of the books, but it also affords excellent facilities for the work of the librarian's assistants, and conveniences for those who have occasion to consult the books.

The Influence of Light upon Tree-Growth.

Among the interesting discussions to be found in Professor Fernow's second annual report on forestry is a brief consideration of the influence of light upon the development of various trees of the forest. The following extracts give the essential portions of it: —

"It is a well-known fact that light is necessary for the development of chlorophyl, and therefore for the life of all green plants, and especially for tree-life and wood-formation. Heat alone, which practically always accompanies light, is not sufficient for this purpose, although it is still an open question as to what the absolute light-requirement of a tree species may be, or how much of the effect of increased light on growth is attributable to the light alone, and how much to the accompanying heat. Yet it is undeniable that there exists a relative difference of light-requirement, not only for different species of trees, but for all other plants.

"In last year's report I alluded to this difference in regard to the forest-weeds, which serve in forest management as an indication of the amount of shade which the trees exert, and with that their capacity of impeding evaporation from the soil. While the rosin-weed, sunflowers, some of the golden-rods (*Solidago nemoralis*), and some of the meadow-grasses, and the fire-weed (*Erechthites hieracifolia*), may be mentioned as requiring full sunlight for their best development, the Indian pipe (*Monotropa*) is most decidedly averse to a high degree of light. The partridge-berry (*Mitchella repens*), and among the grasses *Poa flexuosa*, *brevifolia*, *Festuca nutans*, *Cinna arundinacea*, may be named as seeking the shade. The ground hemlock and rhododendron are also characteristic shade-plants. By careful observation we could make a classification of weeds characterized by their dependence for normal development on various degrees of light and shade.

"The frequently observed change or 'alteration' of the flora, when the original forest is removed, must to some extent be explained by this light-influence.

"The amount of light required is, however, considerably modified by other influences of site. Where the intensity of the sunlight is great, as in southern countries, in higher altitudes, and in dryer climates, and also where the growing season is longer or the number of sunny days greater, a shade-enduring species will be able to sustain still more shade, and a light-needing one may even become shade-enduring. The flora of high altitudes, therefore, is in general decidedly light-needing. The elms, oaks, and ashes, which in northern latitudes are clearly light-needing, may in southern latitudes endure considerable shade.

"Trees are no exception to this rule; and while nearly all develop best, i.e., make the most wood, in the full enjoyment of light, their capacity of preserving their vitality and of developing under the shade varies greatly. While the yew will thrive in the densest shade, a few years of overtopping will kill the larch; so, also, while the beech will grow with considerable energy under the partial shade of such trees as ash, maple, etc., the oak will only just keep alive under the same conditions, and some of the birches would die.

"Favorable moisture-conditions make all species less sensitive to the withdrawal of light; and here, perhaps, the influence of the heat which accompanies the sunlight plays an important part. Therefore, on the fresh soils of bottom-lands, on northern exposures, and in the coves and depressions in the mountains, the light-needing species will be found to suffer less from shading than on dry, poor soils. Even so shade-enduring a species as the spruce becomes sensitive to the withdrawal of light when growing on dryer mountain-sites.

"The observations by which we may arrive at a relative classification of our timber-trees with regard to their light-requirements must therefore be made with due consideration of these modifying influences. The capacity to withstand shade, even in later life (in their youth most trees will stand considerable shade), is noticeable in the denser or less dense foliage, and in the capacity of overtopped individuals or overshadowed branches to preserve their vitality for a longer or shorter time. The observations on this line must, then, be made in the dense forests, in order to be able to judge of their characteristic foliage-development in the shade; for, if grown in the open, so much light is accessible to every part of the crown, that leaf-development, even in the interior of the crown, is unimpeded, and quite a dense foliage is the result. Thus, in the open, the maples, elms, sycamores, black locusts, etc., make good shade-trees, while in the dense forest they thin out and have but scanty foliage. The conifers, which, like the spruces and firs, preserve the foliage of several years, have perhaps the greatest capability of growing under shade, and preserving their foliage, in spite of the

withdrawal of light. But, in the present state of our knowledge, we become painfully aware that we are lacking sufficient data to group even our most important forest-trees in a series according to light-requirements. This is not so, however, in Europe. Some forty years ago German foresters made observations along this line, formulating them and elaborating rules for the management of the various species, especially in thinning, mixing, and cutting for reproduction; and, although these rules have been practised for so long a time based on empirical knowledge, it is only now that Dr. Kienitz offers a physiological explanation of the difference in the behavior of trees under changing light-conditions. He found that on the same branch those leaves which are developed under the full influence of the sunlight are not only, as was known before, often larger and always tougher in texture, and thicker, but they have a larger number of stomata (or 'breathing-pores'), than those formed under less exposure to sunlight. The same, of course, was observed in individual trees grown under shade and in full enjoyment of light. If, then, the trees which have their foliage formed under the shade of outgrowing neighbors are suddenly placed in different light-conditions, the foliage is not adapted to perform its function as energetically as the stronger light necessitates. The buds which are formed in deficient light, show also in their leaves a deficiency in the number of stomata; and in consequence the favorable influence upon wood-formation, due to increased light, for which the thinnings and interlacings are made, become in fact noticeable only the second year, when new buds, developed under the increased light-influence, have formed leaves adapted to the changed conditions. In conifers, which hold their leaves for several years, this adaptation naturally takes a much longer time; and under unfavorable conditions, if moved too suddenly from the shade into the light, they often lose their old foliage, and even die before the new foliage adapted to the light-influence is sufficiently developed to sustain the increased demand of respiration, transpiration, and assimilation.

"The importance of this knowledge becomes apparent when we attempt to formulate the rules for thinnings, etc. There is hardly any line of investigation, observation, and experiment more fruitful, and more needed for the practical purposes of forest planting and management, than to establish this relation of our timber-trees to light-conditions. The rational compositions and form of our plantations, their management and reproduction, are based upon this knowledge, and the proper application of it may be well termed 'the essence of forestry.'

"Observations and experiments, therefore, in regard to the dependence of our important timber-trees upon light-conditions, are among the first to be undertaken by the experiment-stations in the forest and in the nursery.

"Hand in hand with these experiments, will go, of course, the inquiries into the rate of growth and yield before alluded to. If there are old growths at hand, the influence upon the yield of thinning with consequent 'undergrowing' may be ascertained."

ETHNOLOGY.

The Prehistoric Race of Spain.

MESSRS. H. AND L. SIRET have published the results of their interesting archaeological researches in south-eastern Spain, and from their finds trace the history of the primitive people inhabiting that country. The most ancient remains show this people living in the neolithic period; later on, copper and bronze were used. Thus the researches of the authors give interesting confirmation of the recently established fact, that a copper age preceded the bronze age in most parts of Europe. At the close of the bronze age, silver is first used, and fortified villages occur. At the same time the methods of manufacturing bronze are improved. No iron was found in any of the stations of this people. There were two modes of burial: the dead were buried in large clay vessels, or the corpses were burnt. Weapons, ornaments, tools, food, and earthenware are always found in the graves, of which about a hundred were explored. The latter have been studied by Jaques. The results of the latter are summarized by Kollmann as follows. First of all, the principal result is of great value: various races occurred among these early inhabitants. No history mentions the name of this people.

Since the neolithic period it has remained in the same locality. The impression is, that its culture developed continuously without any breaks. Its origin and descent are unknown, but one fact is shown by the forms of the skulls: it was a European people, consisting of European types, the same as live at present in Europe, and which lived at a still earlier period in the caves of Estremadura and at the kitchen-middens of Mugem, or later on in the dolmens near Lisbon. A series of dolichocephalic skulls has been found with an average cranial index of 73.8, and long face. The nose is long and the orbit high. This is the exact counterpart of the long skull of the northern inhabitants of Europe. Besides these, Jaques found a short-headed race, also with long faces, high noses and orbits. Their type also occurs frequently in northern Europe. A third race is also brachycephalic, but its characteristics are a broad, flat face, and strong prognathism. Broca considers this type mongoloid. Nevertheless, from a study of the photographs contained in the work, we assume that this race also is of exactly the same type as the European broad-faced, short-headed races, and does not resemble the Mongols. Besides this, a race with broad faces and long heads, the Cro-Magnon race of French writers was found. The fundamental conclusion from these facts is, that in this early period the shores of the Mediterranean were inhabited by several European races. Kollmann considers this result a confirmation of his theory that the migrating European tribes spread early over the whole continent, and that all European peoples consist of a mixture of these earliest inhabitants.

THE EVOLUTION OF ORNAMENTS.—There are few branches of ethnology in which the usefulness of extensive collections becomes more evident than in the study of the development of ornament. It is only in collections of this kind that incidental ornaments can be distinguished from characteristic ones. Since Holmes's admirable study of American ornaments, a number of essays have been published, most of which refer to the islands of the Pacific Ocean. Some time ago we mentioned Dr. L. Serrurier's study of arrows from New Guinea, which was published in the *International Ethnographical Archive*. The May number of the *Journal of the Anthropological Institute* contains another paper on a similar subject. Mr. Henry Balfour has studied a collection of arrows from the Solomon Islands, which are on exhibition in the Pitt Rivers Museum at Oxford. The ornamental design of these arrows is invariably found immediately above the joints of the reed of which the shaft is made. It usually consists of a number of incised straight lines, blackened, and running parallel to the shaft, so as to form a band round it. Balfour shows that this design originated in the necessary smoothing-off of the joints. When this is done, the fibrous nature of the substance of the reed causes narrow strips to peel away along the length of the shaft. To prevent this peeling extending far, cross-notches were cut. This was the origin of the ornament, which was later on retained, even when other methods of smoothing off the joints were used. Balfour compares this ornament with those of reed arrows from other countries, and shows that it is probably confined to the Solomon Islands, other methods of ornamentation and of smoothing the joint being used by other peoples. He mentions only a single arrow from South America of a similar description.

HEALTH MATTERS.

Diagnosis of Human Blood.

THE diagnosis of human blood is discussed by Dr. Henry Formad in the *Journal of Comparative Medicine*. Especial attention is given to the methods of examining blood-stains and measuring the blood-corpuscles.

For testing the question whether a certain substance is blood or not, the spectroscope and chemical re-agents come into play; but for the recognition of human blood the microscope alone is of any value, and the sole method yet found available with this instrument is that of measurement of the corpuscular elements. The differentiation of mammalian blood from that of lower orders of animals is made easy by the fact that in mammals alone is the cell round and non-nucleated. The differentiation between the blood of man and that of lower mammals depends entirely upon the micrometer.